



⑪ Publication number: **0 571 124 A1**

⑫ **EUROPEAN PATENT APPLICATION**

⑳ Application number: **93303649.3**

⑤① Int. Cl.<sup>5</sup>: **H01Q 1/22**

㉔ Date of filing: **11.05.93**

③① Priority: **21.05.92 US 887434**

④③ Date of publication of application:  
**24.11.93 Bulletin 93/47**

⑧④ Designated Contracting States:  
**DE FR GB**

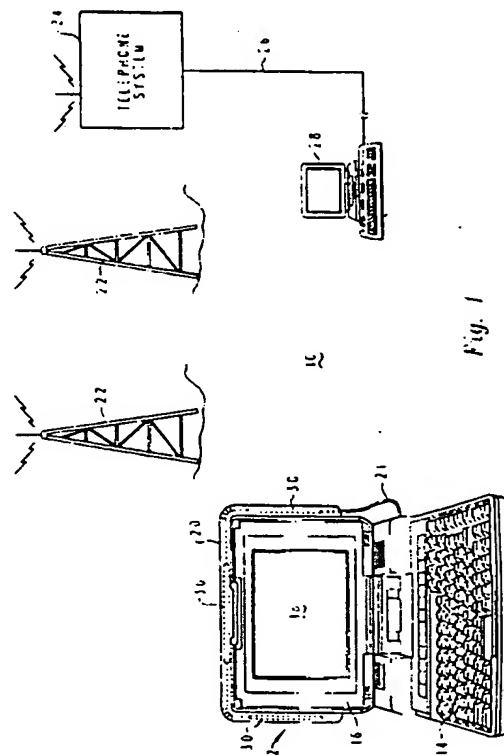
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⑤④ **Mobile data terminal.**

⑤⑦ An external antenna 20 for use with a mobile battery powered data processing terminal 12 is disclosed, the terminal including a radio frequency communication device 36, such as a cellular telephone transceiver. Multiple antenna elements are mounted within a D-shaped flexible tubular member 38 having a very low dielectric constant which is then affixed to the external surface of the data processing terminal, utilizing an adhesive on the flat surface thereof. The flexible tubular member is preferably mounted along at least two edges of the data processing terminal display module such that spatial or polarization diversity for the multiple antenna elements may be provided. A coaxial connector 21 is utilized to couple the multiple antenna elements to a radio frequency communication device within the data processing terminal. In this matter, an external antenna may be added to a battery powered data processing terminal in a manner which will protect the antenna without interfering with radio frequency transmission or reception while simultaneously providing additional protection for the data processing terminal.



The present invention relates to mobile data terminals and in particular to improvements in an external radio frequency antenna for utilization with a mobile data terminal.

Distributed data processing systems are increasingly common in the modern electronic work place. Such distributed data processing systems may include thousands of computers or workstations including main frame computers, so-called "personal" computers, and modern state-of-the-art portable or "laptop" computers. In modern distributed data processing systems many such computers may be linked together utilizing various topologies and different types of networks including Advanced-Peer-To-Peer-Networks (APPN), Local Area Networks (LAN) or various other types of networks. While in the past computer networks are generally coupled together utilizing existing telephone land line systems, or specialized wiring, modern distributed data processing systems often utilize more sophisticated means of communication.

For example, the increasing efficiency and decreasing cost of cellular communication equipment has resulted in the utilization of that technology to couple together multiple computers without the necessity of access to a telephone line outlet. This particular technology is particularly effective in combination with small, portable battery powered laptop or notebook computer in which the necessary modem and cellular communication circuitry are miniaturized and provided in an integral fashion with the computer itself. Often in such a computer, it is possible to remove the fixed disk drive and replace that subassembly with a combination modem and cellular communications device such that the data processing terminal may be coupled to a large network utilizing cellular communications technology. Thus, an operator utilizing such a computer may initiate communications and transfer data between his or her computer and a distributed data processing system without the necessity of access to either telephone lines or power lines.

The increasing utilization of such devices and the after market refitting of existing laptop or notebook type computers with such communications modules result in a problem in the efficiency of the radio frequency communication. That is, devices which are initially designed for utilization with cellular communication circuitry are constructed with internal antenna elements which are optimized for cellular communications; however, the after market refitting of a laptop or notebook computer with a combination modem and cellular communication device often causes a problem, since such devices were not designed initially for cellular communication network linking.

The antenna devices typically utilized for cellular communication generally compose multiple antenna elements, each including a radiating element which is equal in length to some fraction of the wavelength

generally utilized by the cellular communication device. Further, in order to enhance the efficiency of communication, these multiple antenna elements must include elements which are separated by a minimum distance and preferably must be oriented normal to each other in space, in order to provide the necessary separation and spatial diversity.

Thus, upon reference to the foregoing it should be apparent to those skilled in the art that a need exists for an external antenna which may be rapidly and efficiently affixed to a portable data processing terminal in a manner which provides optimum radio frequency communication.

Accordingly the invention provides a mobile data terminal including a radio frequency communication device for transmitting data via a radio frequency communication network, a multi-element radio frequency antenna coupled to said radio frequency communication device, and a case having at least two substantially orthogonal sides, and characterised in that said multi-element radio frequency antenna is mountable on the exterior of said case along said at least two substantially orthogonal sides, with at least one element of said multi-element radio frequency antenna disposed on each of said at least two sides.

The mobile data terminal with external antenna of the present invention may be implemented utilizing for example any battery powered data processing terminal which includes a radio frequency communication device, such as a cellular telephone transceiver. Multiple antenna elements may be mounted within a D-shaped flexible tubular member having a very low dielectric constant which is then affixed to the external surface of the data processing terminal, utilizing an adhesive on the flat surface thereof. The flexible tubular member is mountable along at least two edges of the data processing terminal display module such that spatial or polarization diversity for the multiple antenna elements may be provided. A coaxial connector may be utilized to couple the multiple antenna elements to a radio frequency communication device within the data processing terminal. In this manner, an external antenna may be added to a battery powered data processing terminal in a manner which will protect the antenna without interfering with radio frequency transmission or reception while simultaneously providing additional protection for the data processing terminal. The flexible external radio frequency antenna is deformable about the housing of the mobile data terminal, and therefore may be rapidly and efficiently affixed to it, and furthermore can actually provide some protection for the terminal.

In a preferred embodiment, the multi-element radio frequency antenna comprises a three element radio frequency antenna, said elements being in spaced apart relationship, which is mountable on the exterior of said case along three sides thereof and wherein each of said three elements is disposed on a separate

side of said case.

It is also preferred that the multi element radio frequency antenna is disposed within a flexible insulating elongate member, preferably one having a D-shaped cross-section. The flexible insulating elongate tube is constructed of a flexible material having a dielectric constant less than 0.001, such that radio frequency emissions from said multi-element radio frequency antenna will pass freely through said flexible insulating elongate tube. Preferably the multi-element radio frequency antenna includes means adapted to affix said flexible insulating elongate tubular member to the exterior of said case. One possible affixing means comprises an adhesive backing along at least a portion of a flat surface of said D-shaped cross-section.

Preferably the flexible insulating elongate tubular member has a length greater than the greatest side of said case.

It is also contemplated that a multi-element radio frequency antenna as described above may be sold separately from the mobile data terminal itself.

An embodiment of the invention will now be described by way of example with reference to the following drawings:-

Figure 1 is a partially schematic pictorial representation of a mobile data processing terminal in accordance with the present invention;

Figure 2 is a block diagram of the major subsystems of the portable data processing terminal of Figure 1;

Figure 3 is a sectional end view of one external antenna element of the external antenna of Figure 1; and

Figure 4 is a sectional side view of the external antenna element of the external antenna of Figure 1.

With reference now to the figures and in particular with reference to Figure 1, there is depicted a partially schematic pictorial representation of a distributed data processing system 10 which may include a portable data processing terminal 12 which may utilize an external antenna in accordance with the present invention. Upon reference to the foregoing those skilled in the art will appreciate that while distributed data processing system 10 is illustrated as including only two computers, typically such distributed data processing systems include a large number of computers distributed over a wide geographic area. As illustrated, portable data processing terminal 12 is one of the computers within distributed data processing system 10. Portable data processing terminal 12 is preferably a battery powered laptop or notebook computer which includes a low power display system 16 which preferably provides a display screen 18 which may be implemented utilizing a liquid crystal display (LCD), a gas plasma display or any other suitable technology. Keyboard 14 is provided with portable

data processing terminal 12 and enables the computer user to access and modify data stored within portable data processing terminal 12 in a manner well known in the art.

As those skilled in the art will appreciate it is increasingly common for computers such as portable computer 12 to include therein a miniature cellular telephone system (not shown) which is provided in conjunction with a modem. For example, it is possible to remove the fixed disk drive module typically provided with portable computer 12 and substitute therefore a module which includes a cellular transceiver and associated modem device. Those skilled in the art will appreciate that a modem is a device which may be utilized to convert digital data from a computer to an analog signal which may be transmitted via a telecommunications system. Additionally, such devices convert received analog signals from the telecommunications line to digital data which may be utilized by a computer. As is typical in such systems, a cellular telephone transmits a radio frequency signal via an external antenna 20 which is coupled to a cellular transceiver (not shown) via coaxial cable 21 and which may be implemented utilizing the antenna system disclosed herein. As illustrated, external antenna 20 preferably includes multiple antenna elements 30, depicted in phantom line within external antenna 20.

As is typical in such systems, a cellular telephone communications device transmits a radio frequency signal via an external antenna 20 which may be received and relayed via multiple cellular system antenna 22. Thus, digital data within portable data processing terminal 12 may be converted into a series of analog signals and transmitted, via a cellular telephone system and multiple intervening repeaters to a telephone system 24, in a manner well known to those skilled in the art.

Analog signals thus transmitted may be received by the telephone system and transmitted, via an ordinary telephone land line 26 to a computer 28 within distributed data processing system 10. While computer 28 is depicted as a personal computer, those skilled in the art will appreciate that computer 28 may be implemented utilizing a workstation, terminal or main frame computer, as desired. Typically, computer 28 will also include a modem device permitting data from portable data processing terminal 12 to be transmitted to and received by computer 28 and computer 28 may be linked to portable data processing terminal 12 utilizing cellular technology, rather than telephone land lines.

Referring now to Figure 2, there is depicted a block diagram of the major subsystem components of portable data processing terminal 12 of Figure 1. As illustrated, keyboard 14 and display 16 are coupled to a processor 32. Processor 32 is coupled via bus 33 to modem device 34 which serves to convert digital data from processor 32 into analog data which may be

transmitted via cellular transceiver 36. As depicted, cellular transceiver 26 is coupled via coaxial cable 21 to external antenna 20, which includes a plurality of antenna elements 30.

With reference now to Figure 3, there is depicted a sectional end view of one antenna element 30 within the external antenna of Figure 1. As illustrated, external antenna 20 preferably includes a flexible insulative elongate tubular member 38 which is preferably constructed of a foamed plastic, such as polyurethane, or any other suitable flexible insulative material having a dielectric constant of .001 or lower. As illustrated, the flat surface of flexible insulative elongate tubular member 38 preferably includes a strip of contact adhesive 42 which, in the depicted embodiment of the present invention, may be utilized to rapidly and efficiently mount external antenna 20 to the outer perimeter of display 16, as illustrated in Figure 1. Disposed within flexible insulative elongate tubular member 38 is a ground plane 44, preferably constructed of copper or other highly conductive material, above which is mounted antenna element 48, at a fixed distance from copper ground plane 44, utilizing radio frequency insulator 46. Thus, as those skilled in the art will appreciate upon reference to the foregoing, by disposing multiple antenna elements within flexible insulative elongate tubular member 38 and providing an adhesive backing strip 42, in the manner depicted, a multi-element external radio frequency antenna may be simply and efficiently mounted to multiple sides of portable data processing terminal 12, providing the necessary spatial diversity required to optimize communications efficiency utilizing a cellular communication system antenna.

Referring now to Figure 4, there is depicted a sectional side view of one antenna element 20 of external antenna 20 of Figure 1. As illustrated, antenna element 30 is disposed within a flexible insulative elongate tubular member 38, which is preferably D-shaped in the manner depicted herein. Each antenna element portion 48A and 48B may comprise a one-fourth wavelength antenna element which are coupled together, via coaxial connector 50, and mounted in fixed spatial relationship above copper ground plane 44 utilizing radio frequency insulators 46 in the manner depicted.

Upon reference to the foregoing those skilled in the art will appreciate that herein provided is a new multi-element radio frequency external antenna which is mountable within a flexible tubular member and which may be wrapped around multiple edges of a portable battery powered data processing terminal in a manner which efficiently provides the necessary separation and spatial diversity for optimum radio frequency communications. Those skilled in the radio frequency art will appreciate that multiple antenna elements must be separated by approximately ten inches (25cm) in this frequency range or oriented at

ninety degrees to each other in a manner easily provided utilizing the external antenna described herein.

## Claims

1. A mobile data terminal (12), including a radio frequency communication device (36) for transmitting data via a radio frequency communication network, a multi-element radio frequency antenna (20) coupled to said radio frequency communication device, and a case having at least two substantially orthogonal sides, and characterised in that said multi-element radio frequency antenna is mountable on the exterior of said case along said at least two substantially orthogonal sides, with at least one element of said multi-element radio frequency antenna disposed on each of said at least two sides.
2. The mobile data terminal according to Claim 1, wherein said multi-element radio frequency antenna comprises a three element radio frequency antenna.
3. The mobile data terminal according to Claim 2, wherein said multi-element radio frequency antenna is mountable on the exterior of said case along three sides thereof and wherein each of said three elements is disposed on a separate side of said case.
4. The mobile data terminal according to any preceding claim wherein said multi-element radio frequency antenna is disposed within a flexible insulating elongate member (38).
5. The mobile data terminal according to Claim 4, wherein said flexible insulating elongate member comprises a flexible insulating elongate tube having a D-shaped cross-section.
6. The mobile data terminal according to Claim 4 or 5, wherein said flexible insulating elongate tube is constructed of a flexible material having a dielectric constant less than 0.001, such that radio frequency emissions from said multi-element radio frequency antenna will pass freely through said flexible insulating elongate tube.
7. The mobile data terminal according to claim 4, 5 or 6, wherein the multi-element radio frequency antenna includes means (42) adapted to affix said flexible insulating elongate tubular member to the exterior of said case.
8. The mobile data terminal according to Claim 7, as dependent on claim 5 or 6, wherein said means

adapted to affix said flexible insulating elongate tubular member to said case comprises an adhesive backing along at least a portion of a flat surface of said D-shaped cross-section.

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9. The mobile data terminal according to any preceding claim, wherein said flexible insulating elongate tubular member has a length greater than the greatest side of said case.

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10. A multi-element radio frequency antenna for use in the mobile data terminal of any preceding claim.

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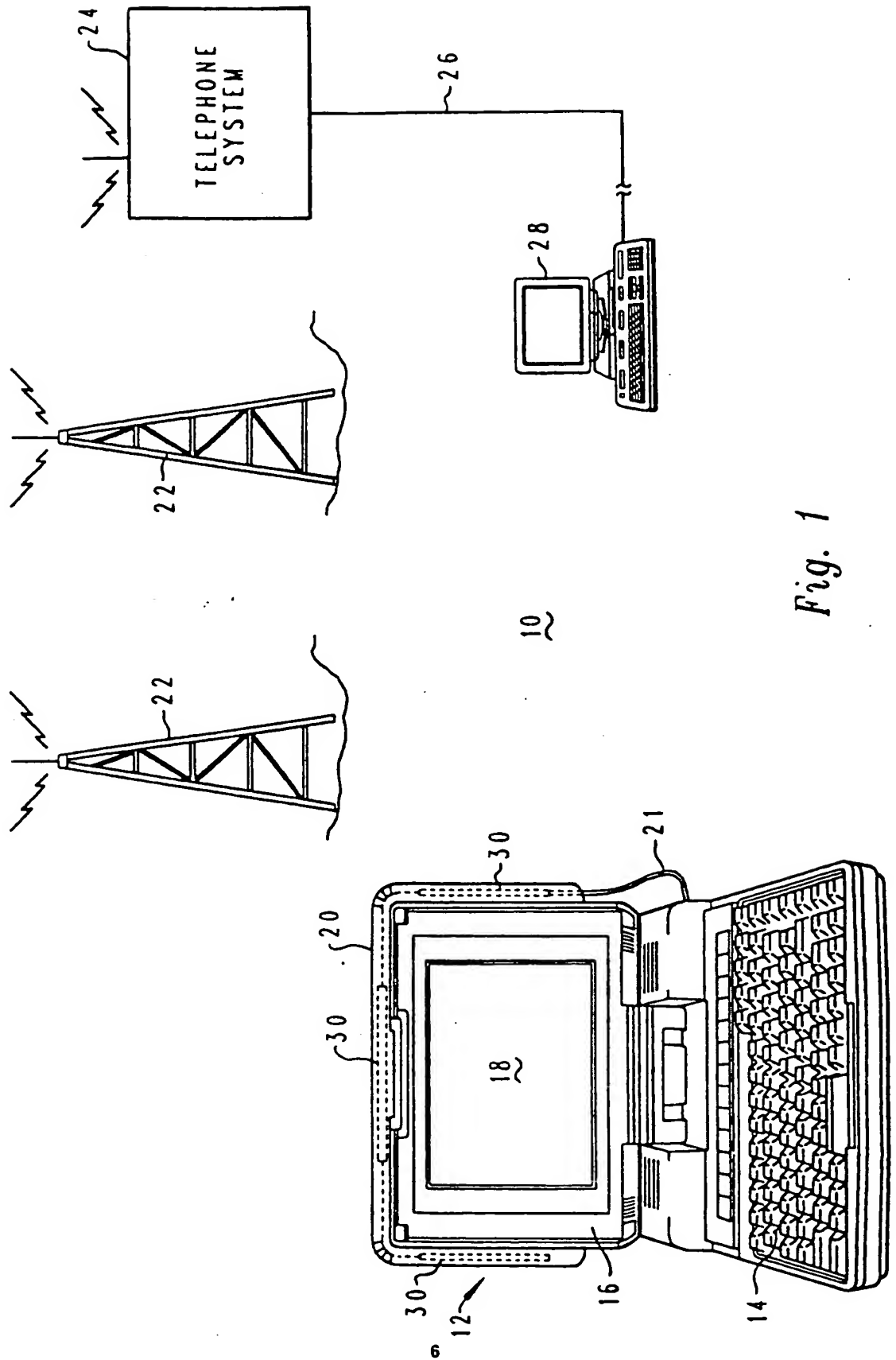


Fig. 1

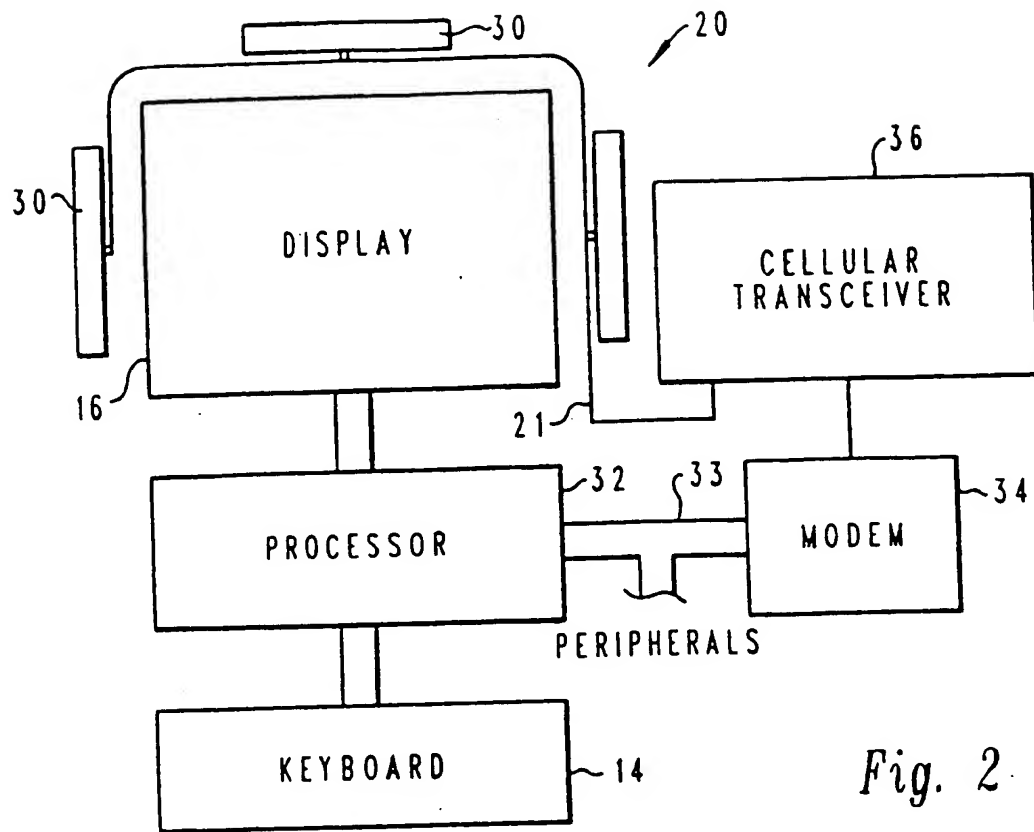


Fig. 2

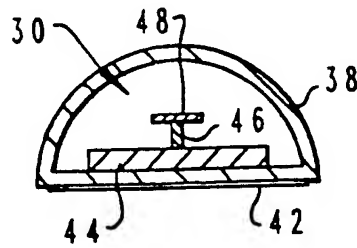


Fig. 3

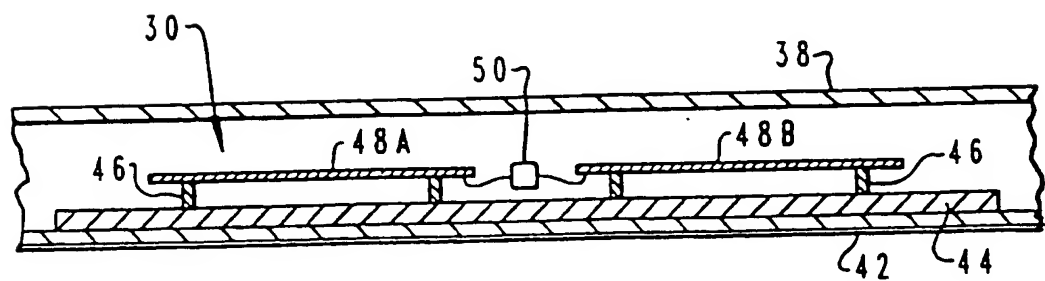


Fig. 4



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## EUROPEAN SEARCH REPORT

### Application Number

EP 93 30 3649

| DOCUMENTS CONSIDERED TO BE RELEVANT   |   |  |
|---|---|--|
| Category  | Citation of document with indication, where appropriate, of relevant passages                             | Relevant to claim<br>CLASSIFICATION OF THE APPLICATION (Int. Cl.5) |
| A   | WO-A-9 104 461 (INTELLIGENCE TECHNOLOGY CORP.)<br>* page 3, line 22 - page 5, line 8 *<br>* figures 1-3 * | 1  |
| A   | WO-A-8 500 480 (MOTOROLA)<br>* abstract *<br>* page 7, line 20 - page 8, line 27 *<br>* figure 1 *        | 1  |
| A   | DE-A-3 712 956 (FRIEMUTH, B.)   |  |
|   |   | TECHNICAL FIELDS SEARCHED (Int. Cl.5)                              |
|   |   | H01Q   |
| The present search report has been drawn up for all claims  |   |  |
| Place of search<br><b>THE HAGUE</b>   | Date of completion of the search<br><b>20 JULY 1993</b>   | Examiner<br><b>JEPSEN J.</b>                                       |
| <b>CATEGORY OF CITED DOCUMENTS</b><br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |   |  |



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